SEMINAR ON:

# IMPACT OF NEW AND PROPOSED EFFLUENT REGULATIONS ON MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT

NOVEMBER 9, 1988

# PROCEEDINGS

ORGANIZED BY:

POLLUTION CONTROL ASSOCIATION OF ONTARIO

ONTARIO MINISTRY OF THE ENVIRONMENT

A2yH



# IMPACT OF NEW AND PROPOSED EFFLUENT REGULATIONS ON MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT

Proceedings of a seminar held

at the

Waterloo Inn, Waterloo, Ontario

NOVEMBER 9, 1988

sponsored and organized by:

POLLUTION CONTROL ASSOCIATION OF ONTARIO

and the

ONTARIO MINISTRY OF THE ENVIRONMENT

Seminar Co-Chairmen: Ralph Luhowy,
Region of Waterloo

Steve McMinn,
M.M. Dillon Limited

TABLE OF CONTENTS Page

ABSTRACT ONLY

## MINISTRY OF THE ENVIRONMENT POLICY UPDATE

by: Nars Borodczak,
Ontario Ministry of the
Environment

An update was presented of Ontario Ministry of the Environment policy on industrial and municipal wastewater regulations, with emphasis on the Municipal Industrial Strategy for Abatement (MISA) program. The schedule for industrial monitoring regulations and the expected timing for the municipal sector were outlined.

## THE SOUTHWESTERN REGIONAL APPROACH
## HOW TO DETERMINE CERTIFICATE OF APPROVAL NUMBERS

By: D. Huber [1]

Each Region of the Ministry of the Environment has a slightly different approach to determine criteria or numbers for Certificates of Approval. Presently, there is an effort under way by the Water Resources Branch in Toronto to try and standardize the approaches and requirements. This paper deals with the approach developed by the Southwestern Region. It is an evolutionary approach, which is still evolving, and is not a cookbook approach which says you must do this then that. It outlines a series of steps that the consultant can go through, with various options, to produce a report that will be acceptable to determine Certificate of Approval criteria by the Region.

This Region like the others has been accused of using many methods to determine Certificate of Approval criteria, e.g. throwing darts, rolling dice or just picking the numbers out of the air. This Ministry's new program MISA BAT-EA (Best Available Technology - Economically Achievable) will raise the minimum standard of treatment required for all major pollution contributing sectors. For the municipal sector, this was the requirement for at least primary treatment (settling for solids removal) and now MISA may raise the minimum treatment level to secondary treatment (settling plus biological oxidation). Wherever MISA takes us, the Certificates of Approval criteria may have to be more restrictive based on receiving stream impact studies. The surface water quality goal of this Ministry, as laid out in the "Blue Book" (Water Management Goals, Objectives and Implementation Procedures of the Ministry of the Environment Revised May 1984), is to ensure that the surface waters of the Province are of a quality that is satisfactory for aquatic life and recreation. This stresses the need to know as much as you can about the waste receiver.

To develop Certificate of Approval (C of A) criteria, one requires information on :local water quality conditions (e.g. the bacteriological, chemical, physical and biological), streamflow/currents, existing water uses along with existing or proposed raw waste strengths and waste flows. The more real data one has available, the easier it is for the consultant to do the job.

---

[1] Douglas M. Huber, Regional Hydrologist and Assoc. Surface Water Evaluator, Southwestern Region, Ontario Ministry of the Environment

The consultant should contact the Technical Support Group in the respective Region to obtain information on the stream-based water quality criteria. These values may be different for different rivers. For example; turbid rivers can handle more phosphorus than clear-flowing rivers and warm-water fishery streams require less dissolved oxygen than cold-water fishery streams. After you have informed them about your type of discharge and approximate volume, they may provide stream based water quality criteria that may include:

| | |
|---|---|
| un-ionized ammonia | dissolved oxygen |
| total phosphorus | suspended solids |
| BOD5 | total chlorine residual |
| hydrogen sulphide | various metals |
| E. coli/fecal coliform | phenols |

These values will be used by the consultant to protect the aquatic life present in the receiver. Also any variation in criteria, summer to winter etc. should be provided at this time. The information from Technical Support must be up to date. An eight-year old memo on water quality is just not acceptable. If the project has been shelved or you have not dealt with Technical Support for over eighteen months about this project then get the information confirmed. There may be new water quality parameters of concern or changes in downstream water uses etc. Additional concerns or restrictions about the discharge should also be identified at this time. There may be seasonal restrictions because of low streamflows or fish spawning. The discharge must not be toxic and this point results in maximum concentrations for un-ionized ammonia, total chlorine residual and heavy metals just to name a few parameters. If the discharge goes to a lake, then information on minimum distance out from shore and water depth should also be provided. Be realistic about the time it takes to amass this information. Just don't walk into a Ministry Office and expect to leave with the required information in a matter of minutes or even hours.

The next step or while your waiting for data or the requested information to be forwarded , get familiar with the existing streamflow data for your discharge location. You may be lucky and have a continuous recording stream gauge at your location but the odds are against it. Determine if pro-rating is acceptable or if you can develop a correlation between daily spot measurements and daily flows at the continuous gauge. A new report dealing with techniques on how to estimate streamflow for ungauged streams from gauged streams will be available from the Water Resources Branch in Toronto during spring of 1989. This report may be of assistance or you may wish to use some other approach. Just explain the approach you want to use and get approval for it now. Also get your approach to

ranking and recurrence interval calculations confirmed be it Gumbel, Log Person etc.

Now that you are familiar with the streamflow data, which flows are you going to use? For a continuous year round discharge, we normally require the 7Q20 (minimum average seven-day streamflow with a 20 year reoccurrence interval) streamflow to be used. For seasonal discharges depending on stream sensitivity, we recommend either a minimum 1 in 10 monthly average or minimum 1 in 20 monthly average. Monthly 7Q10 (minimum average seven-day streamflow with a 10 year reoccurrence for that specific month) may be required for a continuous winter discharge with a drop of storage in the spring. Depending on the exact scenario, we have used minimum weekly flows with 10-year reoccurrence, worst year on record and NO DIRECT DISCHARGE at all. This may force the applicant into infiltration or spray irrigation. This Region also has a dry ditch policy where we allow a discharge from a tertiary (extended aeration, filtration, disinfection and multi point alum injection) treatment plant to a stream that seasonally goes dry. It is our philosophy that some water (nontoxic) in a ditch or stream is better than no water in the ditch or stream. It is up to the consultant to confirm the proposed approach is applicable for the discharge and always has the option of going out and collecting real streamflow data.

Knowledge of background water quality is just as important as knowing estimated streamflows. Upstream concentrations of total ammonia, temperature, pH, BOD5, suspended solids and total phosphorus are required to determine impact from the proposed discharge. If there is no water quality data available for your location you may have to estimate it from a nearby station or again collect your own. You should be aware of seasonal variation, the range of the parameter of concern and how the chemicals interact. Depending on the type of discharge, additional data on metals, phenols etc. may be required. Discuss the available data and explain the way you chose specific values to represent the water quality present in the stream under your discharge scenario.

From here one can quite easily work backwards from required stream concentrations to required discharge concentrations by mass balancing or modelling under many different discharge scenarios. If using modelling techniques, unless you have real data for the variables, keep the model simple. You might as well estimate the answer if you are going to estimate all the input parameters and variables. Again the approach is up to the consultant but an explanation of why this approach is as good as or better than another is required. This automatically leads to the type of treatment process required to meet the required discharge concentrations under different discharge timing options. The list of treatment process options may

included but not limited to:facultative lagoons, aerated lagoons, activated sludge, extended aeration, filters, Sutton concept (extended aeration plus polishing ponds), RBC's or a combination of the above. Storage requirements can be calculated along with discharge to streamflow scenarios using daily, weekly or monthly adjustments.

Preliminary cost estimates for the different processes and discharge schemes that provide acceptable effluent quality can then be worked out by the applicant. A preferred option listing treatment process, storage and discharge timing can then be forwarded for review. You may have noticed that the consultant or applicant has done most of the estimating or documenting of impact to this stage. It is very important that the consultant knows the rules prior to getting to this stage so they know what information will be required for the Certificate of Approval. Once we receive the report, the Ministry will review all the data supplied and approaches used to arrive at the preferred alternative. This should be a relatively simple job if the consultant has followed the recommended approach. Based on this review one of four options will be recommended:

1/ A conditional Certificate of Approval be issued where the system has a defined time frame to get into compliance. These are mainly used on innovative approaches where insufficient data is available to confirm the concept will work. If they are not in compliance by a set date, they must revert to a more conventional system.

2/ A fixed time frame Certificate of Approval be issued where the C of A expires on or before a certain date. This approach is used for staged expansions and allows us to force the completion of the following stages.

3/ A full Certificate of Approval be issued and this will not change until the average daily flows listed are exceeded or a major change in Ministry policy takes place.

4/ Rejection of the full report and the suggestion that the consultant start over again. This should not happen if the consultant has been in contact with this Ministry through all stages of the process.

For either of the first three options, effluent criteria for the proposed discharge will be developed by the Region based on both stream criteria and what the recommended treatment process should produce. This will confirm that whatever treatment process is recommended, it will be operated as efficiently as possible. The Certificate of Approval will included: information on the design (structures) along with recommended design values. These are suggested criteria that the treatment plant should try to achieve. It is nearly impossible to achieve monthly average total phosphorus concentrations of 1 mg/l if you only design for that level. Also, monthly average non-compliance criteria and single sample maximum

non-compliance criteria are given. This forces the treatment process to produce consistent results and not allow short-term discharges of toxic materials. It makes little sense to protect a stream from toxics "on average". Information on monitoring and reporting requirements is also given to document how the treatment system is operating. Rationale for the effluent limits are given along with discharge limits before the system must come up for review or expansion. Other requirements may be also added to the Certificate of Approval.

In summary, it is very simple to understand the need for good frequent communication between the applicant and the Regional Office of this Ministry. The obtaining of stream-based criteria upfront is necessary before any treatment process can be evaluated. Confirm your approaches as you go and there should be no misunderstanding at the time the report is submitted for a Certificate of Approval.

# METAL FINISHING INDUSTRY POSITION

By: Kenneth Coulter, P.Eng.
Canadian Association of Metal Finishers

The Canadian Association of Metal Finishers has been in existence for three years and represents a group of companies in the metal finishing industry. It is comprised of 40 companies with a combined total of 3500 employees. Because it is new it is still growing. It limits its membership to companies who either have waste treatment facilities in place or are in the process of installing them.

Some of the members are quite large companies with only a portion of their operation in metal finishing, while the majority are specialists in metal finishing as a service to other industries. Most of these are referred to as job shops and are owner operated. Some companies employ as few as 10, while others employ 100's.

The processes of the industry include electroplating of various kinds, painting, hot dip galvanizing, electroless coatings, anodizing of aluminum and chemical conversion coatings. Many of these disparate processes are contained in the same facility.

These processes are indispensable to the automotive, aerospace, electronics, fasteners, furniture, electrical, appliances, agricultural implements, transportation, jewelry and recreational industries.

While the public awareness of the industry is mostly confined to the cosmetic aspects of its work, this represents only 15% of its activity. Of far greater importance is its value in providing corrosion protection, conductivity, paintability, solderability, etc.

The industry first became aware of its impact on the environment when companies were given incentives to locate in rural or semi rural areas of Ontario in the 1950's. In many of these areas the sewage treatment systems were non-existent or inadequate. As a result, many of these plants found themselves having to discharge directly to water bodies. The Ontario Water Resources Commission worked with them to try to overcome the problems, but the lack of knowledge and availability of operable waste treatment equipment caused many difficulties. Some companies gave up or moved, others struggled and kept trying until some degree of control was in place. Most of the industry, however, was located in municipalities with sewage treatment plants. Each municipality had a different way for dealing with the industry. Unless a company actually dissolved a pipeline, they largely left the industry alone in the 50's and 60's.

Even as late as the mid seventies, when Environment Canada arranged a seminar jointly with the American Electroplaters Society in Toronto, bringing some of the top people from Europe to show the best available technology at that time, none of the invited guests from municipalities came.

The preparation of the model by-law in 1975 did bring some effort toward enforcement from the municipalities but the degree of control exercised varied tremendously from region to region. The industry was aware, however, of the impending necessity to begin to practice more prevention of losses of potentially hazardous material to the sewer systems. Most companies

introduced various recovery systems into their processes and in general reduced losses to the sewers by 75-80% and introduced pH control in the majority of cases.

When the 1975 model by-law was put in place and inspection systems set up, these reduced levels of contaminents were found to be too high and treatment processes were introduced which destroyed cyanide, precipitated metals as the hydroxide and controlled spills and accidental losses. Recovery systems came on the market that not only limited discharge but recovered some materials for re-use. These included evaporators, De-ionization units, reverse osmosis and electrodyalysis. Some worked, others that worked were not economical. Newer equipment, while more effective has become more expensive. Substitution for toxic materials such as cyanide is now universal where it can be applied. Metal hydroxide sludges which were originally disposed of with 97% water are now dewatered and sometimes dried to minimise volume. Pilot projects are underway to recycle nickle hydroxide, dried, and or fixed, through the refineries.

One of the greatest difficulties in acquiring good pollution control in-plant has been the difficulty of training suitable operating staff. It usually requires a higher technical skill to run a treatment system than the process it is serving. Environment Canada, recognizing this problem, recently set up courses for the training of management, supervisors and operators, in the design, installation and operation of environmental control equipment. These courses were prepared with the assistance of various members of CAMF who also have served effectively as presenters.

In spite of these efforts we have yet to reach the level of control where we are perfect 24 hours per day, 7 days a week.

So far I have refrained from mentioning some of the companies in the industry with a much higher profile than the members of CAMF. The media have given them a great deal of coverage over their various legal battles with municipal authorities. They are not members of our association, nor would we welcome them at the present time into our membership.

There is a considerable spirit of co-operation within the Association, even amongst competitors when it comes to helping solve pollution control problems. The association will do everything it can to help a member who, while trying to meet the regulations finds himself in difficulty with an anomaly in his system. Similarly, the Association is far more interested in working with the municipalities and Environment Ontario in protecting our waterways and treatment systems than being antagonists in legal actions. Far more will be accomplished faster following the route of mutual assistance.

With that brief history of the industry out of the way, I would like to address our response to the recently published model sewer use by-law and the proposed MISA program of the Environment Ontario.

The model sewer use by-law, recently made available to Ontario municipalities, is, we understand, a bridge between the 1975 model by-law and the installation of the MISA program.

This by-law which we believe is already being introduced in a limited number of municipalities does address some of the concerns of the metal finishing industry, but at the same time effectively increases the inequity between municipalities that do enforce and those that do not. The MISA program which should bring about a much higher degree of fairness in enforcement is at least three years away from being in place. In the meantime industries who have millions of dollars in waste treatment are forced to compete with others, sometimes nearby, who have spent little or nothing on waste treatment.

There seems to be a tendency on the part of the persons who have prepared this by-law to downplay the importance of this issue, even though the MISA document of September 1988 recognizes that it can be a matter of concern. Let me show you the costs as established in the United States and published in the April 1987 issue of Plating and Surface Finishing magazine. Costs, in Canada, are at least as high as in the United States as a percentage of the sales dollar. Charts #1 & 2.

These charts show a wide variation in costs related to the size of the companies being reported. A recent Canadian installation in a job shop cost $170,000 for a plant using 80,000 gallons (Imperial), having a sales of CAN. $1,800,000 per year. It's operating cost of waste treatment including the same elements as the American chart amount to $131,000 or 7.3% of sales. However, only 60,000 gallons of water use and $1,000,000 sales are related to production that requires treatment. Thus the cost of treatment is 13.1% for these product lines.

We are particularly anxious to show that using STATSCAN or other national averages do not show the economic impact on individual sectors of this industry. Captive shops are unlikely to report sales of their metal finishing operation only.

While the MISA program suggests that accelerated write-offs will be available both federally and provincially, these are needed to permit the replacement of waste treatment equipment, which is proving to have a shorter life than the process equipment that creates the necessity for treatment.

This problem is not a new one since I can remember a meeting of the Eastern Canada Region of the American Electroplating Society in nearby Breslau when a Kitchener plater was very eloquent in his complaint that he had to treat his waste when his competitors in Waterloo did not. That was over 20 years ago.

With the new by-law in place we will see a great many more court actions with "not guilty" pleas. The very much higher maximum fines called for will see very few guilty pleas when grab sampling has been the basis on which a charge is made. We understand that grab sampling greatly simplifies the determining of non-compliance by a metal finisher, but, it can grossly exagerate the seriousness of the offence. As an example I would like to show the results of a 35 day study made at a facility which has installed the best available technology and has given it careful supervision with a high level of technical skill. Figure 1 shows the daily average discharge of this plant for the 35 day period compared

with the municipal by-law limitation of 5 mg/l. If the company's discharge had been at the limit permitted on average it would have discharged 2.21 kilograms of zinc over a sixteen hour period. The actual overall discharge over the period was only 1.3 kilograms per day. When we look at a specific two day period within this study we see in Figure 2, that an anomaly occurred for a short period of time. Assuming that the period of non-compliance was three hours and that the average discharge was 3 mg/l over the limit, the actual excess of zinc discharged was 185 grams total for three hours on the first day and 308 grams total on the second day.

Both the existing by-law and the proposed model by-law provide for grab samples. This example shows clearly how grab samples distort the actual performance of the company in its efforts to meet the requirements that protect the sewer system, the safety of the workers in the system and the operation of the treatment plant. We note that the proposed by-law in its guidance manual provides for the possibility of sample averaging and the use of proportional flow sampling devices. We would prefer that these latter methods be used exclusively and will co-operate in any program, as is also suggested by the model by-law that would have industry instal such equipment and submit reports as necessary to the appropriate authority. Such reports, would, of course, be subject to confirmation by the authority.

The guidance manual indicates that sampling will be done during regular working hours of an industry, but the most serious hazard for a sewage treatment plant is the concentrated dump that is usually made outside of regular working hours by a plating plant. If there is no treatment system in place these dumps have only one place to go and a grab sample will never pick it up.

Returning to the examples shown above, we would like to bring attention to an anomaly in the by-law in that it penalises a company for any program for the reduction of water use. The by-law prohibits the use of dilution with water as a means of meeting discharge limits. However, if a company reduces its water consumption it must also reduce the amount of restricted matter in its effluent.

The above company produces a quality of water from its final treatment system that permits it to return 40% to its rinsing system. It would seem that it is doing a great service to the sewage plant by reducing the hydraulic load on the system. If it is possible, as the guidance manual suggests to determine if a company is adding water for dilution by checking its records, it must be equally possible to determine the amount of reduction when it occurs and to make a contractual arrangement to permit the company to have 40% greater level of metals in its effluent for compliance on the restricted material.

The steps proposed in the guidance manual for a series of warnings to a company out of compliance are acceptable to our members and would be an improvement on some procedures that have been used in the past. While it might not have been the official policy of a municipality, some inspectors have not followed all of the steps proposed. The guidelines also recommend that the inspectors encourage industry to take a split sample when sampling is being done. This, we not only encourage but cheer. Too often our members have been refused a split sample when they have asked for it and on many occasions the sampling is done without informing the company.

There are some areas in the new model by-law that will need clarification and we are not sure whose interpretation will carry final authority but I will not deal with them at this time.

The MISA program provides us with some encouragement that our concern for uneven and unfair enforcement in Ontario will be addressed. There appears to us much yet to be settled, including the method of financing the program and that the proposed time table may not hold. The recognition in the Environment Ontario publication "Controlling Industrial Discharges to Sewers" under the heading Resource Limitations is most welcome. The time-table indicated in this document would seem to give Environment Ontario authority to correct the present inequities by late 1989 and we sincerely hope that this schedule will be maintained.

The results of the study done for the Ministry by M. M. Dillon, as reported in the above document indicates that the sewer use control program in the United States is the most suitable option for use in Ontario. This does not present a serious problem for us provided we do not get into lock-step with the U.S. and make the same mistakes that they did. Some programs in the United States have proved unworkable and others have put an unnecessary burden on industry without appreciably improving the operation of their POTW's.

We note that the ministry will set provincial regulations for each industrial sector imposing standards based on BATEA - Best Available Technology Economically Achievable. The Ministry is correct in assuming that what is BATEA for one industry may not be appropriate for another. This is also true <u>within</u> the metal finishing industry, since what is appropriate for a metal finisher with one or two elements requiring control, may not be appropriate for another with six or seven elements to control.

We appreciate that economic studies for each industry will be completed prior to the promulgation of BATEA regulations and we hope that these are carried out without bias and with the searching out of <u>all</u> pertinent information. The participants and process by which the Ministry will arrive at BATEA for each industry will apparently include such organizations as CAMF and we will be pleased to bring sources of verifiable information to the process. We presume that we would be included in the sub-committee membership for our industrial category. A very valuable conduit for information on the metal finishing industry is the American Electroplaters and Surface Finishers Society. This Society is a non-profit technical and educational society made up of over 8000 individual members. There are no company memberships. Its membership includes metal finishers, consultants and suppliers of both equipment and chemicals to the metal finishing industry. It meets annually with the American EPA in a co-sponsored three day seminar in January and organizes the largest conference for the industry each June. Within its membership there is to be found the greatest concentration of knowledge in North America on pollution control for this industry.

The Society operates training programs for waste management operators throughout the United States and are now in discussion with another province concerning a program in Canada.

The Society is continuously financing research programs such as one recently finished at the Ontario Research Foundation which investigated the most successful recovery systems available to the industry in Canada. This study was jointly financed by the Ontario Waste Management Corporation. The resulting report was the most sought after document of any of the previous research projects of the Society. Most of the members of the CAMF are contributors to this research program.

In conclusion I would like to emphasize that the members of the Canadian Association of Metal Finishers is both a responsive and responsible group of companies. When we have our opportunity to contribute to the sub-committees studying our industry we will present factual, verifiable information and will assist the sub-committee in identifying suitable and acceptable sources of information. We will seek out information where requested and will make ourselves available for any reasonable amount of time.

WHILE WE SOMETIMES WONDER IF ANYONE LIKES US - WE DO KNOW WE ARE NEEDED.

EXTRACT FROM PLATING AND SURFACING FINISHING MAGAZINE APRIL 1987

A SURVEY OF METAL FINISHING WASTEWATER TREATMENT COSTS
BY DONALD P. DUFFY, GREGOR E. NORGAARD AND JOEL M. SANDBERG

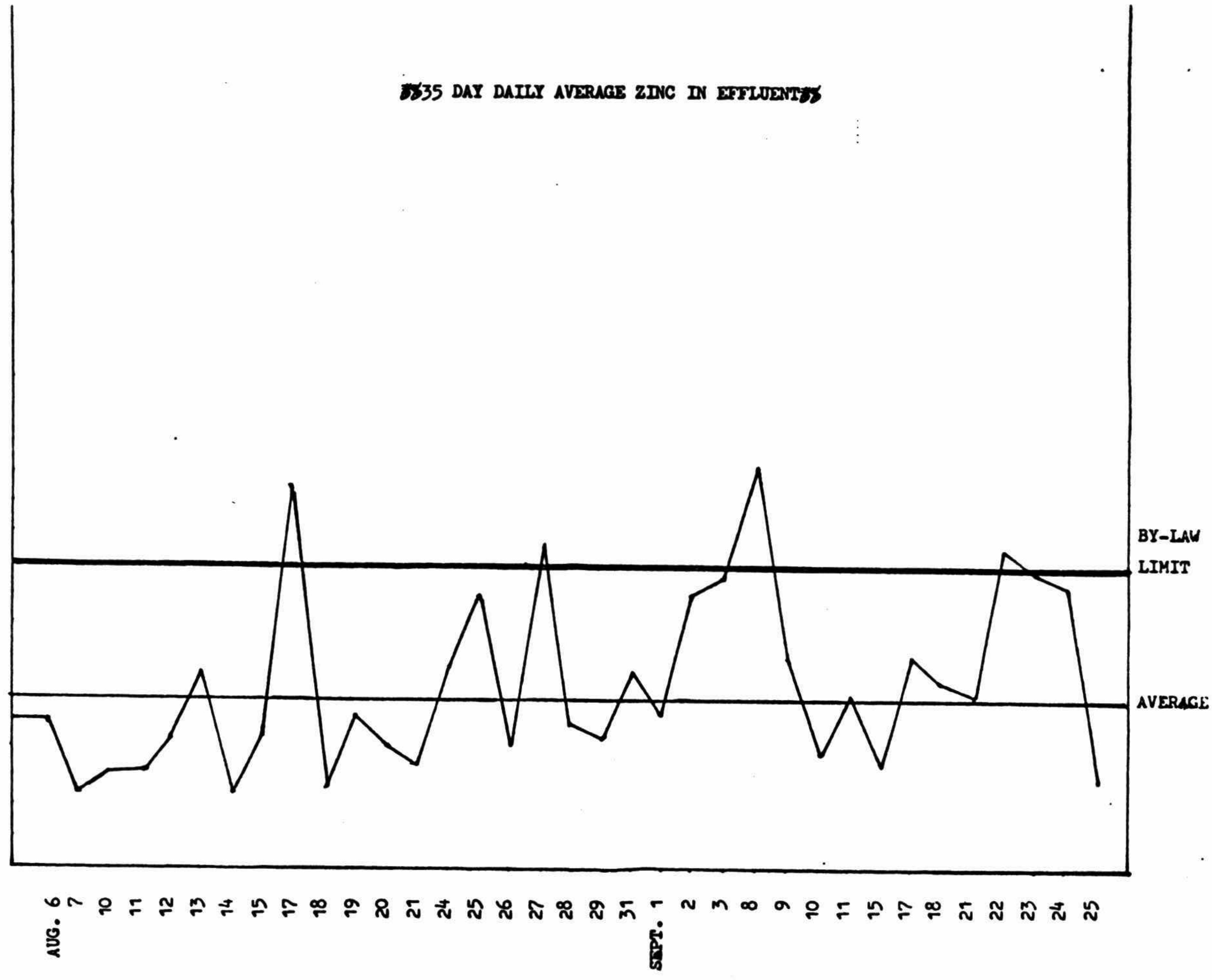
ALL FIGURES IN U.S. & U.S. GALLONS

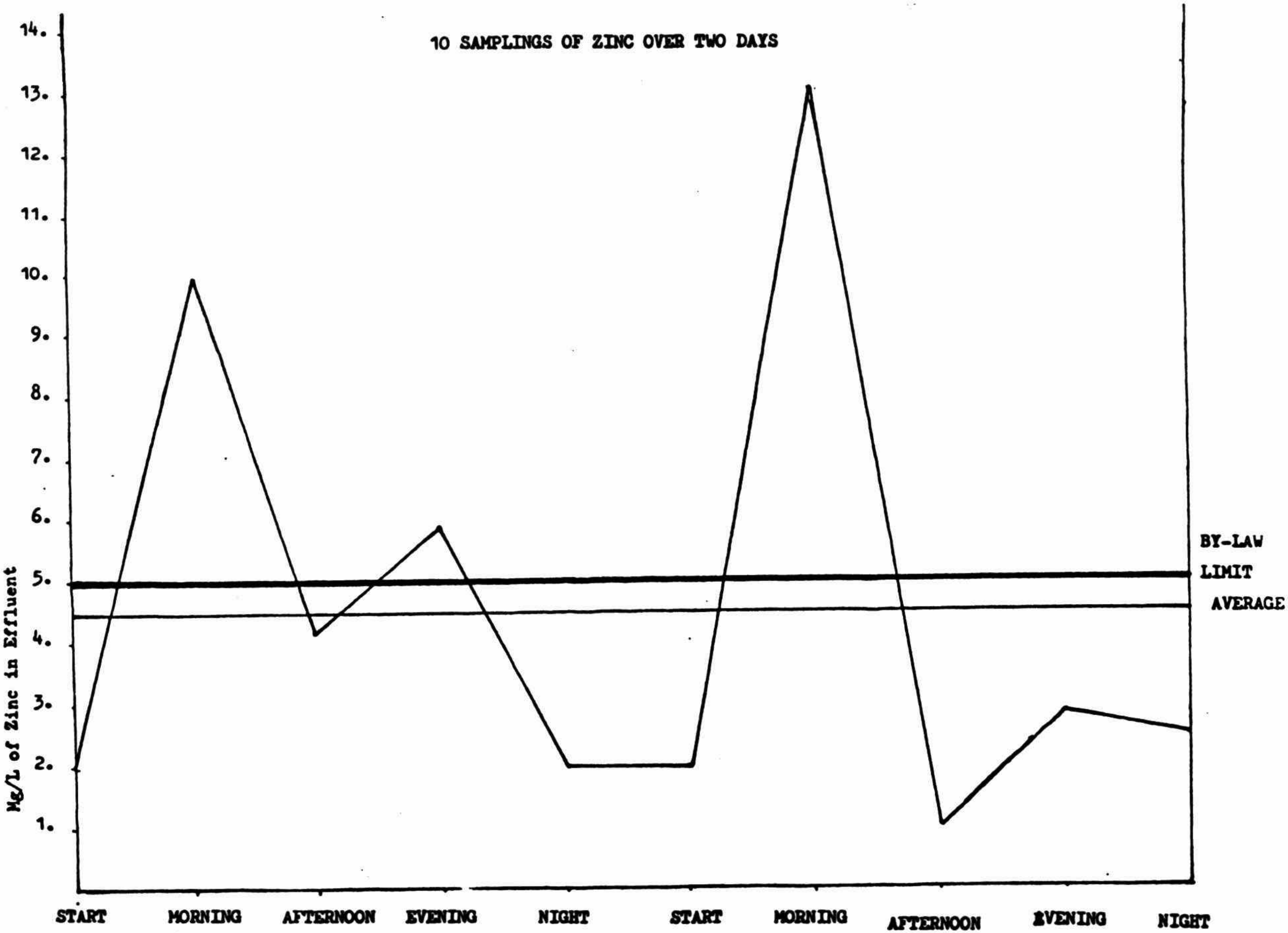
| | TYPE OF OPERATION | PROCESS FLOW GAL/DAY | TOTAL CONC. OF TREATMENT PLANT INFLUENT Metals | Cyanide | Chromium |
|---|---|---|---|---|---|
| #1* | JOB PLATER | 7,000 | 63 | 9 | 6 |
| #2 | JOB PLATER | 10,000 | 37 | 3 | 7 |
| #3 | CAPTIVE PLATER | 13,500 | 306 | 11 | 22 |
| #4 | CAPTIVE PLATER | 15,000 | 13 | 1 | 0.75 |
| #5 | CAPITVE PLATER | 28,000 | 5 | 0 | 3 |
| #6 | P.C. JOBSHOP | 36,000 | 30 | 0 | 0 |
| #7 | JOB PLATER | 45,000 | 106 | 14 | 9 |
| #8 | CAPTIVE PLATER | 65,000 | 90 | 0 | 15 |

ANNUAL WASTE TREATMENT COSTS

| | TOTAL INSTALLATION COST | CHEMICAL | LABOUR | DISPOSAL OF SLUDGE | DEPRECIATION AND OTHER | TOTAL |
|---|---|---|---|---|---|---|
| #1 | 19,300 | 8,462 | 25,284 | 6,000 | 5,146 | 44,892 |
| #2 | 100,000 | 10,882 | 14,872 | 35,640 | 20,300 | 81,694 |
| #3 | 430,000 | 11,300 | 116,551 | 36,792 | 90,000 | 254,733 |
| #4 | 250,000 | 5,216 | 42,312 | 19,402 | 65,750 | 132,680 |
| #5 | 200,000 | 6,653 | 11,610 | 23,220 | 56,600 | 98,083 |
| #6 | 477,000 | 16,495 | 17,280 | 27,360 | 97,751 | 158,886 |
| #7 | 200,000 | 21,084 | 31,381 | 32,076 | 41,100 | 102,761 |
| #8 | 120,000 | 50,357 | 39,330 | 30,444 | 35,560 | 156,691 |

* THIS IS A BATCH TREATMENT OPERATION
ALL OTHERS ARE CONTINUOUS FLOW AND AUTOMATED


35 DAY DAILY AVERAGE ZINC IN EFFLUENTS
1.
2.
3.
4.
5.
6.
AUG. 6
7
10
11
12
13
14
15
17
18
19
20
21
24
25
26
27
28
29
31
SEPT. 1
2
3
8
9
10
11
15
17
18
21
22
23
24
25
BY-LAW
LIMIT
AVERAGE


10 SAMPLINGS OF ZINC OVER TWO DAYS
Mg/L of Zinc in Effluent
14.
13.
12.
11.
10.
9.
8.
7.
6.
5.
4.
3.
2.
1.
BY-LAW
LIMIT
AVERAGE
START
MORNING
AFTERNOON
EVENING
NIGHT
START
MORNING
AFTERNOON
EVENING
NIGHT

# POLLUTION CONTROL PLANNING AND BASIN MANAGEMENT IN THE REGION OF WATERLOO

by

G. Zukovs, S.G. Nutt and G. Godin
CANVIRO Consultants
Waterloo, Ontario

## INTRODUCTION

The Regional Municipality of Waterloo is experiencing an unparalleled period of industrial, commercial and residential growth. This growth has placed a significant burden on all facets of the municipal infrastructure, including sewage collection and treatment. At the same time, increasingly stringent effluent quality requirements for conventional and trace contaminants, fueled by concerns regarding receiving water quality, have placed an additional burden on the existing municipal waste water treatment facilities. Large capital expenditures will be needed to maintain the existing level of service without impeding the rate of growth in the Region or adversely impacting on the environment.

In recognition of the need for capital expenditure and the necessity to ensure that such expenditures were judiciously managed, the Region undertook a study aimed at establishing a systematic plan for the orderly expansion and upgrading of the waste water treatment plants (WWTPs) in the Region over the next 30 years. This paper presents an overview of the planning procedures used and the approach taken to establish short-term and long-term facility expansion requirements[1,2].

## BACKGROUND AND OBJECTIVES

The sewage treatment requirements of the Regional Municipality of Waterloo are provided by eleven WWTPs as identified in Table 1. These facilities discharge approximately 162,500 $m^3/d$ of treated effluent to the Grand River, either directly (Kitchener, Waterloo, Preston, and Galt WWTPs) or indirectly via the Speed River (Hespeler WWTP), the Conestogo River (St. Jacob's WWTP), the Nith River (Wellesley, Baden, New Hamburg, and Ayr WWTPs) and the Canagagigue Creek (Elmira WWTP).

Table 1
TREATMENT FACILITIES LOCATED IN THE WATERLOO REGION

| WWTP | Service Area Population (Dec. 31, 1986) | Type of Treatment | Rated Capacity ($m^3$ x 1000/day) |
|---|---|---|---|
| Kitchener | 149,988 | Conventional Secondary | 122.74 |
| Waterloo | 72,438 | Conventional Secondary | 45.46 |
| Cambridge (Galt) | 48,501 | Conventional Secondary | 38.641 |
| Cambridge (Preston) | 17,734 | Conventional Secondary | 16.866 |
| Cambridge (Hespeler) | 10,636 | Modified Secondary (High Rate Activated Sludge) | 9.319 |
| Elmira | 7,361 | Conventional Secondary and Tertiary | 4.545 |
| New Hamburg | 4,496 | Aerated Lagoons | 2.296 |
| Ayr (West Dumfries) | 1,448 | Extended Aeration | 1.181 |
| St. Jacobs | 1,345 | Oxidation Ditch | 0.954 |
| Baden | 1,083 | Extended Aeration | 0.923 |
| Wellesley | 1,008 | Extended Aeration | 0.50 |

The Grand River Basin has been the subject of extensive investigation under the Grand River Basin Water Management Study[3]. This study identified serious concerns with respect to total phosphorus loadings, un-ionized ammonia concentrations and oxygen-demanding carbonaceous and nitrogenous materials from municipal sewage treatment plant discharges. In addition, the high industrial contribution

to the Elmira WWTP produces concerns with respect to discharges of phenolic compounds. Some river reaches have also been identified as areas of water quality concern because of toxic substances, suspended solids, trace contaminants and bacteria.

Addressing the identified water quality concerns in the receiving streams was an objective of the 30-Year Plan for Wastewater Treatment in the Region, as was addressing the new and proposed effluent regulations which were expected to have an impact on the capability and capacity of the existing facilities. Specifically, the objectives were:

1) To review the operational status of each WWTP with respect to process and mechanical equipment, hydraulic and organic loading conditions, and performance.

2) To forecast loading conditions (hydraulic and organic) to the end of the 30-year planning period (2017).

3) To review the current effluent quality requirements and to estimate the ultimate effluent quality requirements for each WWTP and to determine the impact of these requirements on plant capacity and the potential for plant expansion.

4) To assess the implications of extraneous flows due to infiltration/inflow (I/I) on the hydraulic capacity of the WWTPs.

5) To develop a systematic plan for expansion and, where necessary, upgrading of the WWTPs in the Region to meet growth requirements, and to develop current and future performance objectives for the duration of the 30-year planning period.

APPROACH

In order to develop the 30-Year Plan for the Region, each WWTP was subjected to a detailed review of historical performance over a two-year period to determine present hydraulic and organic loading conditions and to establish performance characteristics. Onsite plant surveys were undertaken at all facilities to define process, mechanical, and physical upgrading requirements. At the larger facilities (Kitchener, Galt, Preston, and Hespeler), detailed process audits were performed to establish plant capacity. Details of the procedures used during these process audits have been presented elsewhere[4,5]. Briefly, the audits involved detailed monitoring of process conditions using online instrumentation and automatic data acquisition equipment to establish dynamic patterns in the process and to allow an assessment of hydraulic and organic load limitations in the facility. Oxygen transfer measurements on existing aeration hardware were a key component of these process audits. From the data generated, an accurate estimate of plant capacity could be made and the need for upgrading and expansion to handle future loads could be defined. An audit was not conducted at the Waterloo WWTP, the second largest facility in the Region, because it was already at hydraulic capacity and undergoing expansion.

Future flow and load projections were developed to the year 2017, based on Regional and local Planning Department population forecasts and 1986 per capita flow and loading data. Adjustments were made to account for abnormal industrial growth where appropriate.

In conjunction with the MOE, future effluent quality requirements were developed for each WWTP. The water quality management objectives stated in the MOE Blue Book[6] formed the basis for establishing future allowable receiving water loadings from each WWTP. The Grand River Simulation Model (GRSM) was employed to assess water quality impacts

and allowable loadings for WWTPs discharging to the Grand River. Other more conventional modelling techniques were employed to estimate impacts and allowable loads for the other WWTPs.

Statistical analysis of WWTP flow records, along with a review of previous collection system studies, were used to estimate the extent of I/I problems at each facility. The economic ramifications of I/I removal from each collection system were estimated based on the proportional reduction in the variable O&M costs for that facility.

From these analyses, upgrading and/or expansion requirements at each WWTP were established. In each case, maximizing the use of existing facilities was emphasized. Where appropriate, allocations of discharge loadings between WWTPs on the same receiving stream were considered to maximize basin assimilative capacity while minimizing overall capital expenditure. In situations where space or receiving water quality constraints were identified, alternative approaches, such as combining flows from smaller WWTPs for treatment at a central facility, were evaluated as a means of maintaining waste water treatment service. Capital and O&M cost estimates were developed for all projects identified, including up-front study costs. The individual WWTP project costs were amalgamated into a Region-wide 30-Year Plan according to the priorities assigned to each individual project. The 30-Year Plan developed by this approach was intended to forecast key events related to waste water treatment services in the Regional Municipality of Waterloo and to provide budgetary cost estimates for fiscal planning purposes.

## STATUS OF WWTPs IN THE REGION

Several of the WWTPs in the Region were undergoing upgrading or expansion due to capacity or performance limitations identified prior to the start of the plan development stage. The status of the Region's facilities at the

start of the Plan development stage is briefly summarized in Table 2. Notable projects that had already been identified, and to which capital funds had been committed, included upgrading of the Hespeler and Kitchener WWTPs, and expansion of the Waterloo WWTP.

Table 2

STATUS OF WWTPs IN THE REGION

| Facility | Status |
|---|---|
| 1. Kitchener | - At 54 percent of design capacity.<br>- Upgrading of RAS/WAS metering and control being implemented.<br>- Installation of DO monitoring and control in progress. |
| 2. Waterloo | - Expansion underway to increase capacity to 72.7 x $10^3$ $m^3/d$.<br>- Collection system study underway. |
| 3. Galt | - Expansion/upgrade anticipated in 1988/89. |
| 4. Preston | - At 53 percent of design hydraulic capacity.<br>- Organic overloading from local industries identified. |
| 5. Hespeler | - Improvements in aeration and raw sewage pumping being implemented.<br>- Additional need for secondary clarification contingent on performance after initial modifications. |
| 6. Elmira | - Severe I/I problems in collection system.<br>- Plant approaching rated capacity. |
| 7. New Hamburg | - Experiencing I/I difficulties. |
| 8. Ayr | - Anticipate adequate capacity to beyond 2017. |
| 9. St. Jacobs | - Hydraulically and organically overloaded. |
| 10. Baden | - Experiencing I/I difficulties. |
| 11. Wellesley | - At rated hydraulic capacity.<br>- Collection system study in progress and I/I reduction being considered. |

As shown in Table 3, it was identified that several of the Region's WWTPs would be subject to more stringent effluent requirements than specified in MOE's Policy 08-01 and Policy 08-04 within the 30-year planning period. These restrictions generally applied to discharges of phosphorus and ammonia. Specifically, phosphorus removal to levels of less than 1 mg/L would be required at Kitchener, Waterloo, Galt, and, seasonally, at Hespeler. Ammonia removal requirements would apply at Kitchener, Waterloo, Galt, Preston, Hespeler, New Hamburg, St. Jacobs, and Wellesley. The projected lowering of effluent objectives for the Elmira WWTP were based on maintaining the same receiving water loads for $BOD_5$, TSS, phosphorus, TKN, ammonia, and phenol at the projected future plant discharge of $5.8 \times 10^3$ $m^3/d$ as were presently required for flows up to the rated capacity of $4.545 \times 10^3$ $m^3/d$. These specific water quality-based effluent objectives would be over-and-above the requirements to achieve the $BOD_5$, TSS, and TP objectives outlined in Policies 08-01 and 08-04 on a monthly basis, and the impending requirements of MOE's MISA program.

The compliance status of these facilities, based on MOE's Report on the 1986 Discharges from Municipal Wastewater Treatment Facilities in Ontario[7] is summarized in Table 4. With the exception of the Hespeler WWTP, all facilities were in compliance with annual $BOD_5$ and TSS objectives. Non-compliance with monthly TP objectives occurred at Waterloo, Preston, Hespeler, Elmira, St. Jacobs, Baden, and Wellesley. Of these, all WWTPs except Elmira and Hespeler achieved an annual average of 1.0 mg/L TP or less.

## KEY FINDINGS OF THE 30-YEAR PLAN

Major capital projects were forecast for all facilities in the Region within the 30-year planning period, with the exception of the Ayr WWTP where only equipment replacement costs were identified. At two other facilities (New Hamburg and Baden), the timing and extent of future

Table 3
ANTICIPATED WWTP EFFLUENT OBJECTIVES

| Facility | Rated Capacity ($10^3m^3$/d) | 1986 Average Flow ($10^3m^3$/d) | 2017 Design ($10^3m^3$/d) | Receiving Stream | Anticipated Design Objectives * | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $BOD_5$ | SS | Total P | TKN | Total Ammonia | Total Phenols (µg/L) | Total Residual Chlorine | Total Coliforms (org/100 mL) | |
| Kitchener | 122.74 | 63.4 | 96.7 | Grand River | 15 | 15 | 0.7 | - | 2.0 | - | - | - | to 90.9x$10^3m^3$/d |
| | | | | | 15 | 15 | 0.66 | - | 1.9 | - | - | - | to 96.7x$10^3m^3$/d |
| Waterloo | 45.46 | 46.1 | 78.3 | Grand River | 15 | 15 | 0.80 | - | - | - | 0.5 | 200 | to 54.6x$10^3m^3$/d |
| | | | | | 15 | 15 | 0.60 | - | 1.8 | - | 0.5 | 200 | to 72.7x$10^3m^3$/d |
| | | | | | 15 | 15 | 0.55 | - | 1.7 | - | 0.5 | 200 | to 78.3x$10^3m^3$/d |
| Galt | 38.641 | 30.1 | 48.0 | Grand River | 15 | 15 | 0.6 | - | 2.0 | - | - | - | to 61.4x$10^3m^3$/d |
| Preston | 16.866 | 8.9 | 3.4 | Grand River | 15 | 15 | 1.0 | - | 15 | - | - | - | to 16.9x$10^3$/$m^3$/d |
| | | | | | 15 | 15 | 1.0 | - | 2 to 4 | - | - | - | to 34x$10^3$/d |
| Hespeler | 9.319 | 5.48 | 9.9 | Speed River | 15 | 15 | 0.66/1.0 | - | 4.0 | - | 0.5 | 200 | to 13.6x$10^3$/$m^3$/d |
| | | | | | 15 | 15 | 0.50/1.0 | - | 3.0 | - | 0.5 | 200 | to 18.2x$10^3m^3$/d total P May 1-Sept 30/ Oct 1-Apr 30 |
| Elmira | 4.545 | 3.98 | 5.0 | Canagagigue Creek | 7.5 | 15 | 1.0 | 3.5 | 7.5 | 6.5 | - | - | to4.5x$10^3m^3$/d TKN-Apr 1-Oct 31 $NH_3$-N-Nov 1-Mar 31 (1) |
| | | | | | 5.5 | 11 | 0.7 | 2.5 | 5.5 | 5.0 | - | - | to 5.8x$10^3m^3$/d TKN-Apr 1-Oct 31 $NH_3$-N-Nov 1-Mar 31 |
| New Hamburg | 2.296 | 1.69 | 2.0 | Nith River | 15/30 | 15 | 1.0 | 8.0 | 3.0 | - | - | - | to 2.3x$10^3m^3$/d will require 217,000 $m^3$ of storage & streamflow proportional discharge $BOD_5$ May-Oct/Nov-Apr |
| Ayr | 1.181 | 0.40 | 0.80 | Nith River | 15 | 15 | 1.0 | - | - | - | - | - | to 1.2x$10^3m^3$/d |
| St. Jacobs | 0.954 | 1.130 | 1.70 | Conestogo River | 15 | 15 | 1.0 | - | 15/5 | - | - | - | to 1.82x$10^3m^3$/d |
| Baden | 0.923 | 0.68 | 0.87 | Baden Creek | 15 | 15 | 1.0 | - | - | - | - | - | to 0.92x$10^3m^3$/d stream water quality poor; MOE desires no additional loadings |
| Wellesley | 0.50 | 0.64 | 0.896 | Nith River | 15 | 15 | 1.0 | - | 5.0 | - | - | - | to 1.09x$10^3m^3$/d will require 81.8x$10^3m^3$ of storage & streamflow proportional discharge |

* All units in mg/L unless otherwise stated

(KIA2/109w)

**Table 4**
**COMPLIANCE STATUS OF REGION's WWTPs**

| Facility | Compliance Status* $BOD_5$ | TSS | TP |
|---|---|---|---|
| Kitchener | Yes | Yes | Yes |
| Waterloo | Yes | Yes | No (2) |
| Galt | Yes | Yes | Yes |
| Preston | Yes | Yes | No (3) |
| Hespeler | No | No | No (8) |
| Elmira | Yes | Yes | No (8) |
| New Hamburg | Yes | Yes | Yes |
| Ayr | Yes | Yes | Yes |
| St. Jacobs | Yes | Yes | No (4) |
| Baden | Yes | Yes | No (4) |
| Wellesley | Yes | Yes | No (1) |

Notes: * $BOD_5$ and TSS based on annual average requirements. TP based on monthly requirements. Number of months out-of-compliance is shown in brackets.

works was contingent on the success of efforts to remove excessive amounts of extraneous flow from the collection system. The estimated capital expenditure (1987 dollars) required to maintain service in the Region and to meet the anticipated effluent quality requirements which may be placed on the facilities was approximately $120 million, including $20 million in committed projects. The largest expenditures, exclusive of those already committed, were forecast for the Galt and Preston WWTPs.

Capital expenditures were forecast as a result of both plant expansion requirements over the planning period and plant upgrading requirements to meet new or proposed effluent-quality objectives. Table 5 shows the major capital works identified for facilities in the Region. Planning projections suggest that the Galt, Preston, Hespeler, Elmira, St. Jacobs, and Wellesley WWTPs will require expansion beyond their present rated hydraulic capacity before 2017 to meet residential and industrial demands. In addition, the Waterloo WWTP, which was undergoing expansion during development of the 30-Year Plan to increase its rated

Table 5

PROJECTED MAJOR CAPITAL WORKS PROGRAMS

| Facility | Undertaking | Timeframe |
|---|---|---|
| 1. Kitchener | - Digester expansion/upgrading | 1994 |
| | - Aeration upgrade to achieve nitrification | 1994 |
| | - Final effluent filtration | 1994 |
| 2. Waterloo | - Final effluent filtration | 1991 |
| | - Plant expansion and upgrade | 2004 |
| 3. Galt | - Upgrade of aeration system | 1989 |
| | - Plant expansion and upgrade | 2000 |
| 4. Preston | - Upgrade of existing facility | 1990 |
| | - Plant expansion and upgrade | ≅ 1995 |
| 5. Hespeler | - Upgrade of existing facility | 1988-1990 |
| | - Plant expansion and upgrade | 2012 |
| 6. Elmira | - Plant expansion and/or effluent transfer to Grand River | 1990 |
| 7. St. Jacobs | - Plant expansion, possibly in conjunction with Elmira | 1989 |
| 8. Wellesley | - Plant expansion | 1989 |

capacity, would require a second expansion to further increase capacity before 2017. Thus, of the eleven WWTPs in the Region, seven would require expansion at some time during the planning period. Of these seven WWTPs, five facilities (Waterloo, Galt, Preston, Hespeler, and Elmira WWTPs) would also be subject to more stringent effluent regulations during the same 30-year time period. As a result, the capital works projected for these facilities also included an upgrading component to increase plant performance from the standpoint of organic removal, phosphorus removal and/or ammonia-nitrogen removal. The Kitchener WWTP, which was projected to be operating at only 80 percent of present rated capacity at the end of the planning period, would

require capital works due entirely to increasingly stringent effluent quality objectives which would be applied before 2017.

In some instances, it was shown that large capital expenditures at one facility might by postponed or delayed by improvements made at another facility. For example, trade-offs were shown to exist between the Kitchener, Preston, and Galt WWTPs in terms of effluent load allocations and Grand River water quality. Improvements beyond the maximum allowable effluent un-ionized ammonia concentrations or total phosphorus concentrations at one or two of these facilities could be traded against the effluent objectives required for a third facility.

Treatment plant process audits undertaken at the larger facilities were also successful in identifying potential avenues of capital cost saving through process optimization. For example, large capital expenditures had been originally forecast for the Kitchener WWTP to achieve the nitrification objective proposed. As part of the process audit, oxygen transfer tests demonstrated that the potential existed to achieve nitrification within the existing facility by lower capital cost improvements to aeration hardware and implementation of dissolved oxygen monitoring and control techniques. The in-plant tests demonstrated that existing oxygenation capacity was adequate to beyond the year 2000 and that minor upgrading could improve the transfer capability to meet demands for nitrification to near the end of the planning period.

## EFFECT OF EFFLUENT REQUIREMENTS ON THE PLAN

New and proposed effluent requirements impacted significantly on the outcome of the planning process. As noted, six of the eleven facilities in the Region were subject to more stringent effluent quality objectives because of water quality concerns. All facilities will be impacted by the change from the historical annual averaging of efflu-

ent quality for assessing to the monthly averaging and by the still undefined MISA requirements. It is difficult to break down the capital costs in the 30-Year Plan into components which were associated with expansion to meet capacity requirements, with upgrading to maintain or meet present effluent requirements, and with upgrading to meet new and proposed effluent requirements. However, as a rough estimate, up to 25 percent of the total capital expenditures forecast and committed may be directly associated with the new effluent requirements. These requirements could have been substantially higher without prudent evaluation of the capabilities of the existing hardware, and consideration of alternative approaches to meet water quality concerns.

## REFERENCES


1. Canviro Consultants. A Thirty-Year Plan for Waste Water Treatment, Volume 1, Summary Report. Prepared for the Regional Municipality of Waterloo. November 1987.

2. Canviro Consultants. A Thirty-Year Plan for Waste Water Treatment, Volume 2 - Technical Report. Prepared for the Regional Municipality of Waterloo. December 1987.

3. Grand River Implementation Committee. Grand River Basin Water Management Study. 1982.

4. Canviro Consultants. Evaluation of the Potential for Energy Savings and Nitrification at the Kitchener Water Pollution Control Plant. Prepared for the Regional Municipality of Waterloo and Environment Canada. November 1986.

5. Stephenson, J.P., S.G. Nutt, and G.W. Speirs. "On-Line Instrument and Micro-Processor Based Audit of Activated Sludge Systems". Presented at the Annual Conference of the Instrument Society of America ISA/87, Los Angeles, Ca. October 1987.

6. Ontario Ministry of the Environment. Water Management Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment. May 1984.

7. Ontario Ministry of the Environment. Report on the 1986 Discharges from Municipal Wastewater Treatment Facilities in Ontario. October 1987.

# IMPACT ON DESIGN AND OPERATION OF MUNICIPAL TREATMENT PLANTS

Steve McMinn, M.M. Dillon Limited - Design
Bob Pickett, Metro Toronto Works Department - Operations

## 1. DESIGN

### (a) GENERAL

The Municipal/Industrial Strategy Abatement (MISA) initiative, combined with a generally increased stringency in effluent quality and in the definition of compliance, is changing the design process for all treatment facilities.

As an example of the impact on small facilities, we can look at the Village of Lucan sewage treatment expansion project. Lucan is located 30 km north of London, and is only one of many small municipalities with similar projects now underway in South-western Ontario.

The existing 13 acres of facultative lagoons which serve a population of 1,600 persons have been over capacity for some years now. The lagoons, originally designed for continuous discharge, were later designated by Ministry of the Environment (M.O.E.) as a seasonal discharge (twice per year) system. With a requirement to store and treat sewage without discharge from May until October, the lagoons actually fill and begin to discharge by July. Development restrictions on subdivision approval have been in place for a number of years, but additional flows from previously approved developments have compounded the problem.

The lagoons discharge to an agricultural drainage ditch which then transports effluent approximately 1500 m to the Little Ausable River. The ditch and the river experience periods of zero flow.

Stream quality degradation, as measured by free ammonia, Five-day Biochemical Oxygen Demand ($BOD_5$), Phosphorus (P) and Dissolved Oxygen Parameters, was attributable directly to seasonal discharge from the lagoons.

By-passing of raw sewage was occurring at the single pump station in the Village and from at least one other location along the sewer system.

Population projections for the Village indicated a considerable population increase and Village Council was in favour of growth.

Obviously, something had to be done to solve the environmental problem and meet the demand of increased population.

Effluent guidelines were developed for the new 20-year population of 3,000. The new or upgraded facility would continue to discharge to the land drainage system.

(b) EFFLUENT GUIDELINES

(i) Biochemical Oxygen Demand (BOD)

| | |
|---|---|
| * Non-freezing period | 5.0 mg/L |
| * Freezing period | 10.0 mg/L |

* Freezing: Average of Daily Mean Ambient Temperature equal to or less than 0°C

Biological treatment alone cannot ensure that the non-freezing period criteria can be consistently achieved. Even appropriately designed, seasonal discharge facultative lagoons will not meet these criteria. Aerated lagoons would require a solids separation step, probably settling plus filtration. An activated sludge system will also require the filtration phase.

(ii) Suspended Solids (S.S.)

| | |
|---|---|
| Non-freezing period | 5.0 mg/L |
| Freezing period | 10.0 mg/L |

The same considerations apply here as for the $BOD_5$ requirements. Assuming biological treatment, achieving the $BOD_5$ criteria will also mean that S.S. goals will be met.

(iii) Total Ammonia Nitrogen

| | |
|---|---|
| Non-freezing period | 2.0 mg/L |
| Freezing period | 4.0 mg/L |

This is the most influential determinant in treatment process selection.

The efficiency of biological nitrification is dependent on, among other things, temperature, pH and Dissolved Oxygen Concentration. (Providing an adequate sludge age is, of course, a basic requirement).

Nitrification becomes temperature dependent at operating temperatures less than 12-15°C, severely inhibited below approximately 7°C and below 5°C almost non-existent.

Of viable treatment systems, only the extended aeration and rotating biological contactor (RBC) options can provide the required level of nitrification during the freezing period. Lagoon technology is not suitable.

(iv) Total Phosphorus

| | |
|---|---|
| Non-freezing period | 0.3 mg/L |
| Freezing period | 0.8 mg/L |

This reinforces the need for effluent filtration, obviously demands high chemical addition and may require multiple point chemical addition.

(v) Dissolved Oxygen

| | |
|---|---|
| Non-freezing period | 5.0 mg/L |
| Freezing period | 5.0 mg/L |

May require post aeration facility.

(vi) E. Coli

| | |
|---|---|
| Non-freezing period | 200/100 mL |
| Freezing period | 200/100 mL |

Disinfection, which to obtain non-toxic effluent cannot be by chlorination unless followed by dechlorination, will most likely be by UV disinfection.

(c) OTHER DESIGN CONSTRAINTS

(i) No By-Pass

Smaller communities experience high peak to average flows. When combined with a leaky sewer system and interconnection with storm-type flows, it is appropriate to provide flow

equalization. This not only makes it more likely that the stringent effluent guidelines can be consistently met, but may allow reduction in the size of those plant processes (clarifiers, filters) that are sized for peak flows.

(ii) Compliance

As well as the requirement to meet more stringent effluent criteria, these criteria must be complied with on a more consistent basis than in the past. It is necessary to accept and treat (at least to primary level) all sewage which enters the sanitary sewer system, including in some cases, returned flows from combined sewer overflows. Some plants may be required to accept, and handle without passthrough, certain toxic parameters. Redundancy in unit processes, process controls systems, increased operator training, conservative design to accept peak flows and shock loadings all result from this more strict compliance requirement.

(iii) MISA Regulations

MISA regulations are not expected to further impact many of the small to medium facilities which are already subjected to strict effluent guidelines, particularly where industry is not a factor. Where toxic wastes from industry (non-categorical or SIDS) do pass through the municipal plant, further municipal treatment processes may be a local option.

(iv) Discharge to Match Assimilative Capacity

In general, the criteria considered in today's paper will permit continuous discharge even when zero flow is available in the receiver (in this case, a drainage course or small stream). The effluent is classified as non-toxic to aquatic life and available dilution is not considered as allowing for effluent to be of a reduced quality.

(d) THE SELECTED DESIGN SOLUTIONS

Abandon existing lagoons
Flow equalization
Extended aeration for nitrification
Effluent filtration
Ultraviolet disinfection
Aerobic sludge digestion

The effluent criteria effectively excluded the lagoon option and required the higher cost solution, namely a mechanical treatment plant. Local conditions did not allow incorporation of the existing lagoons, even had they been shown to be of benefit.

(e) THE POST-MORTEM

- Is the effluent criteria logical for a small municipality discharging to a sensitive receiver?
- Is the provincial grant money being effectively used?
- Are there less expensive, reliable treatment options (the "Sutton" concept)?
- Are individual project costs being assessed as part of an overall provincial expenditure?
- Should effluent guidelines which are provided by the Province need to be rigorously justified.
- Is lagoon technology now obsolete?
- Should more affordable techniques, such as wetlands, be implemented more aggressively, perhaps using special funding for innovative approaches.

## 2. OPERATION

(a) GENERAL

Having dealt with some of the possible impacts that the new and proposed effluent guidelines will have on the design of municipal treatment plants, this portion of the paper will deal with some of the operational problems posed by these guidelines.

In order to illustrate some of the operational impacts, we will introduce another treatment plant's Certificate of Approval which governs the effluent quality and the special conditions of operation.

The plant selected is the Humber Treatment Plant located in Metropolitan Toronto. This activated sludge was commissioned in 1960. It has a present day capacity of approximately 410,000 cubic metres per day and is being expanded to 473,000 cubic metres per day. The plant serves a population of 540,000 people and receives flows from residential, industrial and commercial sources.

Upon the expansion of the secondary treatment capacity from 410,000 $m^3/d$ to 473,000 $m^3/d$ in 1988, the plant was issued its first ever Certificate of Approval, with terms governing its effluent quality.

The effluent objectives stated in this Certificate are not that comprehensive.

(b) EFFLUENT OBJECTIVES

(i) Design Objectives

| Effluent Parameter | Effluent Concentration | Total Loading From Effluent |
|---|---|---|
| Total Phosphorus (P) | 1.0 mg/L | 172,000 kg/year |
| Suspended Solids (S.S.) | 15.0 mg/L | |
| Five-day Biochemical Oxygen Demand ($BOD_5$) | 15.0 mg/L | |

(ii) Operating Objectives

| Effluent Parameter | Effluent Concentration | Total Loading From Effluent |
|---|---|---|
| Total Phosphorus (P) | 1.0 mg/L | 172,000 kg/year |
| Suspended Solids (S.S.) | 25.0 mg/L | |
| Five-day Biochemical Oxygen Demand ($BOD_5$) | 25.0 mg/L | |

The objectives do not seem particularly onerous, however, one cannot help noticing that Design Objective and Operating Objective for Phosphorus are equal. This situation cannot help but put extra pressures and demands on the operator to run the facilities exactly as designed, with no margins as provided for in the Suspended Solids and Five-day Biochemical Oxygen Demand limits. It should also be noted that the Phosphorus requirement is based on a monthly average whereas the Suspended Solids and the Five-day Biochemical Demand requirements are based on an annual average.

The special conditions of the Certificate call for the maintenance of records on all raw or partially treated sewage for all by-pass occurrences. As well the influent and effluent shall be analyzed for:

Total Phosphorus (P)
Total Kjeldahl Nitrogen (TKN)
Ammonia Plus Ammonium Nitrogen
Nitrite Plus Nitrate Nitrogen
Five-day Biochemical Oxygen Demand ($BOD_5$)
Suspended Solids (S.S.)
Chlorides
Conductivity
Total Coliform Bacteria
Fecal Coliform Bacteria
Fecal Streptococcus

These conditions are not particularly difficult to deal with given that there are laboratory facilities located at the treatment plant capable of handling this type of analysis. It should be noted, however, that conditions surrounding the recording of the by-pass occurrences, provides no relaxing of the effluent guidelines during these events. Nowhere in the Certificate is there a provision for an excursion caused by storm or wet weather flows.

In order to more fully review the implications that these effluent guidelines will have on operations, we will lock at three areas:

(1) Operations and Maintenance Procedures and Practices
(2) Storm Flows
(3) Costs

(c) OPERATION AND MAINTENANCE PROCEDURES AND PRACTICES

It is obvious that we will have to move from training by osmosis to training of a more formal nature. In order to demonstrate a due diligent defence, it must be shown that formal operating procedures are in place and that personnel are familar with these procedures. These procedures must be in a written form in order to ensure that there is no misunderstanding. Having said that these procedures must be written, this does represent a bit of a problem. If we were to review the operating manuals for a facility of the size of the Humber Treatment Plant, one could envision a manual the size of several encyclopedia. It is obvious that the manual itself will provide little protection if the people, who will have to use it, have not been trained.

Certainly, the Certification of Operators will provide us with a means of ensuring that all our operators are measured against a common yardstick. This is not to say that Certification by itself will solve the problem of qualified personnel. We must institute training programs which will ensure the operators are prepared to handle the problems they will face when operating the treatment plant.

In order to have proper operations the facilities must be properly maintained. This will call for written procedures and schedules to ensure that the proper maintenance is being conducted. Here is another area where training will be required in order to ensure that the maintenance personnel are properly skilled. Part and parcel of the maintenance program will be the need to have stand-by equipment, to be put in service whenever maintenance will be required on the operating equipment. This is common practice in the Water Supply industry, where they have defined the "firm" capacity which recognizes the possible loss of equipment due to maintenance.

(d) STORM FLOW

I have deliberately put storm flow as a separate area to review because it is not handled in the Certificate of Approval governing effluent guidelines. In the previous section dealing with design, there is no provision for storm flow in the Certificate for the Lucan facilities. In the same fashion, the Humber Treatment Plant's Certificate mentions that records must be kept of the flows, quality, duration and volume, however, no provision is made in the effluent guidelines to exclude the storm flow data from the monthly and annual averages. If the intent is to provide the quality of treatment to all flows, then facilities will have to be sized for treatment of storm flows. The dilemma here is for what intensity of storm would you design?

(e) COSTS

Everything we have stated in the two previous areas has a cost associated with it, whether it is an operating cost or a capital cost. If we review the operating costs that will be experienced by these guidelines, there will be costs for training of personnel and for the trainers who teach the staff. As well, there will be extra staff required to cover the plant while some of the operators are at training courses. There will also be costs for the development of these courses. There will be a cost associated with the preparation of manuals. One example of these costs, we have received a cost for the preparation of a manual, for automated digestor operation at one of the Metro Toronto Plants, of approximately $30,000.00.

We must also consider the cost for doing the necessary effluent analysis. In the case of the Humber Treatment Plant, daily analysis is conducted on the influent and effluent for:

Total Phosphorus (P)
Total Kjeldahl Nitrogen (TKN)
Five-day Biochemical Oxygen Demand ($BOD_5$)
Suspended Solids (S.S.)

plus Ammonia, and Ammonium Nitrogen on the effluent only:

Other analysis includes:

- Settled Sewage Suspended Solids and $BOD_5$
- Mixed Liquor Suspended Solids
- Return Sludge Suspended Solids
- Primary Sludge Total Solids and Volatile Solids
- Thickened Waste Activated Total Solids and Volatile Solids
- Weekly Digested Sludge Total Solids and Volatile Solids
- Filter Cake Total Solids
- Filtrate Suspended Solids
- Monthly analysis influent and effluent for heavy metals
- Monthly analysis of digested sludge for heavy metals

The present annual cost for our laboratory services is approximately $1,370,000.00. This is the cost to run five laboratories, one at each of the four treatment plants and our Industrial Waste Laboratory. We conduct approximately 127,000 analyses on 74,000 samples. We are presently expanding our Industrial Waste Laboratory and are adding the capability to do trace organics, with the exception of dioxins, furans and PCB's. The cost of the facilities is about $5,000,000.00, including the laboratory equipment. We will be able to conduct analysis for heavy metals, phenols, greases and oils, bacteriology and trace organics.

If we look at possible capital costs,the cost to handle wet weather flow at the Humber Treatment Plant is estimated to be $32,000,000.00, for an additional 59,020 $m^3/d$ of secondary treatment capacity. This figure was obtained from a recently completed study (Humber Sanitary Trunk Sewer System and Treatment Plant Study, July 1988, UMA Engineering Ltd.) on the Humber Treatment Plant. Even this figure is based only upon a five-year storm.

The requirement for stand-by equipment for "firm" capacity during scheduled maintenance also has its associated cost. One can use the estimation of approximately $9.08 per litre for additional secondary treatment capcity or $18.16 per litre for primary plus secondary, when calculating the cost for stand-by facilities.

(f) IMPACT OF MISA

If we are to consider the imapct that MISA will have on the previous three areas of concern, perhaps the greatest impact will be on the analytical work that will be required. Presently, Metropolitan Toronto pays approximately $60,000.00 to sample four treatment plants' influent and effluent for heavy metals and trace organics. This works out to approximately $15,000.00 per plant per sampling. The forty plant studies conducted by the Ministry of the Environment (M.O.E.) cost approximately $2,000,000.00 for analysis of the influent, effluent and sludges, on two occasions per plant. Analysis was conducted for heavy metals, trace organics and the conventionals, i.e. $BOD_5$, S.S. TP, $NH^3$, $NO_2$, TKN, $Cl_2$. The M.O.E. has recently released a report on Laboratory Facilities capabilities to handle the MISA sampling (M.M. Dillon, July 1988). In this report, the cost for a Total MISA Characterization was broken down as follows.

| **Low** $ | **Median** $ | **Average** $ | **High** $ |
|---|---|---|---|
| 1,247.05 | 3,509.35 | 4,042.78 | 11,701.70 |

The report goes on to say that they feel that there is sufficient laboratory capacity to handle the MISA analysis.

My sense is that we will experience problems with the cost of the MISA sampling. Unless the M.O.E. provides some means of certifying the laboratories, we could have problems with data reliability. This complicated by delays in obtaining results. We can presently wait as long as three months from the time of sampling to receipt of a final report, this for just one sampling of the four plants. When this sampling frequency is increased, delays can only become more of a problem.

If we add the requirement to do Bio-Assay's, which is completely new to most, if not all the treatment plants, there will be a need to hire more staff to handle this load, or the work will have to be contracted out.

## (g) SUMMARY

The new effuent analysis and the MISA program will require more formalized operations and maintenance procedures in order to ensure adherence to the guidelines. There will also be a requirement for better training. Certification of Operators is a way of ensuring an adequate standard of knowledge.

Storm flow or by-pass caused by storm flow must be recognized in the Certificate of Approvals. To insist on no by-pass is simply ignoring the inevitable and would not stand up to the scrunity of cost benefit analysis.

There must be redundant or stand-by equipment and tankage to permit regular maintenance of equipment without the loss of capacity. We must also deal with the problems that the MISA effluent analysis will bring. The cost is prohibitive and the ability of the laboratories to handle this load is questionable.

ABSTRACT ONLY

## THE USEPA TOXIC REDUCTIONS PROGRAM

Henryk Melcer, of Environment Canada's Wastewater Technology Centre, stepped in at the last minute to present a paper on behalf of the United States Environmental Protection Agency, on their procedures to evaluate methods of measuring toxicity in municipal sewage treatment plant effluents.

The paper also reported on a series of laboratory simulations which measured the effectiveness of different unit processes in removing toxicity. These processes included air stripping, filtration, adsorption and ion exchange. Extremely high removal rates were experienced when processes were run individually or in series on target toxic chemicals.

## THE IMPACT ON MUNICIPALITIES

by: Clare Bauman,
Regional Municipality of Waterloo

I wish, first, to extend to you greetings from the Regional Municipality of Waterloo. I understand these one day seminars are usually held in Toronto. I hope you enjoy your brief stay here and that your deliberations today are profitable.

I will give you a brief background profile of the Municipality to provide comparisons. The Regional Municipality of Waterloo is comprised of seven Municipalities, contains 519 square miles and approximately 325,000 people.

The Region has 1,200 industrial and commercial enterprises which are served by separate storm and sanitary sewers. The waste water is directed to one of eleven waste water treatment plants before discharge to a receiving watercourse. The industrial base consists of the following major groups:

i) food and kindred products,
ii) textile,
iii) beverage,
iv) metal fabricating and finishing,
v) chemical and allied products,
vi) automotive,
vii) foundaries,
viii) rubber and miscellaneous plastic products,
ix) leather and leather products.

but has industry in all catagories provided in the new model by-law.

Industrial discharge inspection, analysis, and enforcment began in the Region in 1973. The Regional program is supported by a laboratory facility which provides the testing and reporting to local businesses.

| | | |
|---|---|---|
| Statistics are: | Staff: | twelve |
| | Vehicles: | four |
| | Lab Space: | 7,500 square feet |

The operating budget for 1988 is $438,806.00. The Region anticipates revenue from industrial surcharges to exceed $1,250,000.00 in 1988.

The proposed annual current and capital budgets are as follows:

- Total current $17,307,000.00 which includes laboratory, waste water treatment and administration.

- Total capital $17,799,000.00 which includes construction of a new laboratory at $3,300,000.00.

**<u>OVERHEAD:</u> WASTE WATER TREATMENT RATES** (Table 1)

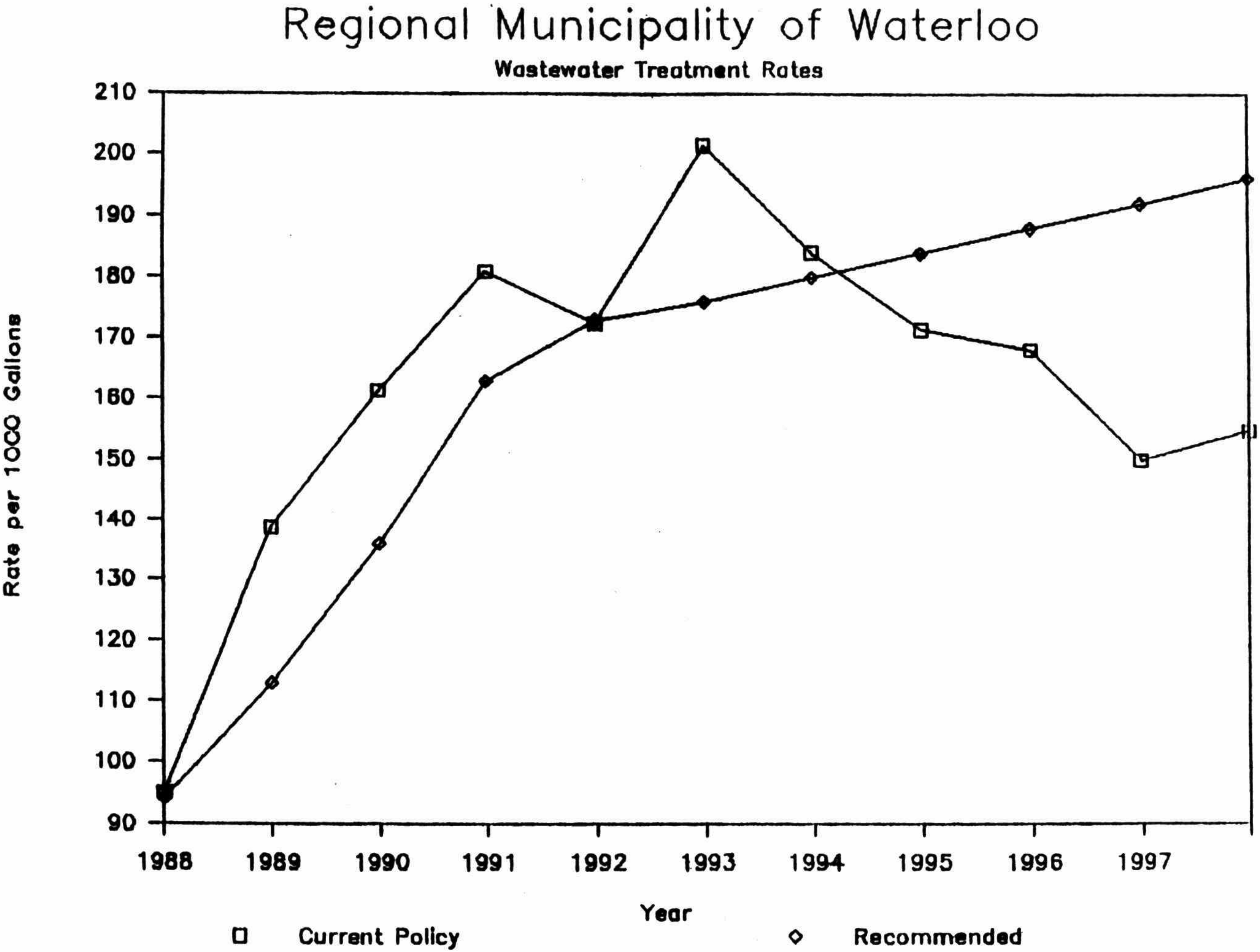

Regional Municipality of Waterloo
Wastewater Treatment Rates
Rate per 1000 Gallons
210
200
190
180
170
160
150
140
130
120
110
100
90
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
Year
Current Policy
Recommended



TABLE 1

This overhead shows the Waste Water Treatment Rates anticipated during the next ten years. The rapid rise is caused by capital projects, largely in waste water upgrades, expansions, and the significant impact of new criteria for waste water plant design and discharge. The total expenditure in capital projects over ten years is expected to exceed $100 million.

I would like to examine the estimated Capital and Operating costs for enforcement as our Region forsees it, together with cost estimates in the Ministry of the Environment Discussion Paper "Controlling Industrial Discharges to Sewers".

<u>OVERHEAD:</u> ESTIMATED ANNUAL MUNICIPAL OPERATING COSTS (Table 2)

<u>OVERHEAD:</u> REGION OF WATERLOO ESTIMATED ANNUAL OPERATING COSTS (Table 3)

The Region of Waterloo has an advanced program in place. We do not expect to receive a large amount of funding from the Ministry of the Environment to help us develop programs.

However, the Region has received a committment for 1/3 funding of a new Regional Laboratory estimated to cost $3.3 million. This M.O.E. committment still leaves $2.2 million to be born locally.

| ESTIMATED ANNUAL MUNICIPAL OPERATING COSTS | | |
|---|---|---|
| Cost Feature | Current Cost | Cost Under Proposed Program[1,2,3] |
| Total sewer use program cost per year | $3,800,000 | $20,600,000 |
| Municipal personnel required | 95 | 270 |
| Cost per capita | $0.54 | $2.73 |

<u>Note:</u>

[1] Total annual sewage servicing operating budget in 1985 (excluding capital) in Ontario was $269,000,000.
[2] Total annual sewage servicing charges collected in 1985 in Ontario was $231,000,000.
[3] Total annual municipal budget in 1985 (excluding capital) in Ontario was $6,513,000,000.

TABLE 2

| REGION OF WATERLOO ESTIMATED ANNUAL OPERATING COSTS | | |
|---|---|---|
| Cost Feature | Current Cost | Cost Under Proposed Program |
| Total sewer use program cost per year | $500,000 | $1,200,000 |
| Municipal personnel required | 12 | 26 |
| Cost per capita | $1.42 | $3.43 |

TABLE 3

## Municipal/Industrial Strategy for Abatement

The Municipality will have to await the final Regulations for the Municipal Sector in order to fully access costs. However, if organic contaminants are as ubiquitous as heavy metals, we can anticipate a significant workload to generate. This work will be processed through the staff and laboratory already anticipated. Philosophically, it is the Region's policy to protect the waste water treatment plants through point source control at the industries.

## Waste Water Treatment Plant Discharges

This is the area of large, capital intensive upgrades and expansions. In order to achieve no degredation of receiving water quality objections, an expansion to a waste water treatment plant automatically triggers more stringent discharge criteria.

In order to maximize the servicing ability for waste water treatment and not overstress the receiving watercourse, the Region and Ministry of the Environment have attempted to balance loading throughout the drainage basin. You will hear more of this in a paper this afternoon.

I will illustrate what happens to project costs as these new objectives "click in".

This project is the Cambridge (Galt) Waste Water Treatment Plant expansion/upgrade. I would like to demonstrate several aspects of the enhancement grant. The discharge criteria for the expanded project are for a maximum 30 day consecutive average flow rate of 56,800 $m^3$ play.

| | | |
|---|---|---|
| These are: | Suspended Solids | 15 mg/l |
| | Total Phosphorus | 0.6 mg/l |
| | $NH_3$-N | 2 mg/l |
| | B.O.D.$_5$ | 15 mg/l |

Non-compliance levels were established as
B.O.D. - 25 mg/l. Phosphorous 0.6 mg/l
S.S. - 25 mg/l. Ammonia 3 mg/l

It is also necessary in this facility to provide for no planned by-passes. These costs are based on estimates included in the "Draft" Pre-Design report.

1. 33% subsidy on items that are required for purposes of plant upgrading to meet more stringent requirements of M.O.E., etc.
   - No "planned" bypasses
   - Reduced ammonia - nitrogen in effluent
   - No increase in phosphorus discharge

2. Items as per cost estimates in Pre-Design Report

   i) Raw Sewage Pump Station $1,280,000 - to meet "noplanned by-passes", capacity in excess of peak dry weather flow to meet no by-passing requirement i.e.
   PDWF $ 90,900 $m^3$/day
   PWWF 171,100 $m^3$/day

   Difference 80,200 $m^3$/day

   $\frac{80,200}{171,100} \times \$1,280,000$ $ 600,000

ii) Aeration Tanks - \$2,850,000

Increase in capacity of expansion purposes

56,800 - 38,600 = 18,200 $m^3$/day

Increase in capacity of nitrification purposes

38,600 - 21,000 = 27,600 $m^3$/day

For nitrification purposes

$$= \frac{17,600}{18,200 + 17,600} \times 1,850,000 \qquad \$1,400,000$$

iii) Blower Bldg/Return

Sludge Pumping - \$1,700,000

Same % as aeration tanks — \$ 836,000

iv) Final Clarifiers \$1,590,000

Surface area existing 1641$m^3$

To increase capacity of expansion would require

$$\frac{56,000 - 38,650}{38,600}$$

= 51.8% i.e. = 850 $m^2$

Actual increase - 1508 $m^2$

Part for nitrification =

1508-850 = 658 m2

therefore costs for nitrification

$$= \frac{658}{1508} \times \$1,590,000 = \qquad \$\ 722,000$$

v) Effluent Filtration - $2,400,000

the entire item is for purposes of increased restrictions on phosphorus discharges $2,400,000

vi) Ultraviolet Reactors - $1,100,000

$\frac{38,600}{56,800}$ x 100% is for improved effluent (68%)

$\frac{18,000}{56,800}$ x 100% - 32% is for expansion purposes

therefore 68% x $1,100,000 is for improved effluent and more restrictive handling/feeding facilities $ 746,800

vii) Electrical - $900,000

This is difficult to apportion. Items which relate to more restrictive requirements include

- standby power to eliminate by-passing
- increased treatment particularly aeration to meet reduced ammonia - nitrogen requirements.
- effluent filtration to meet reduced phosphorus concentrations on the plant effluent

| | |
|---|---|
| It would seem that at least 50% of the costs relate to the increased treatment requirements | $ 450,000 |
| viii) Effluent Pumping Requirement - $250,000<br>This entire item is for purposes of increased environmental proctection | $ 250,000 |
| ix) Site Improvements - $500,000<br>Very little of this item is for enhanced treatment but perimeter berms are for increased environmental protection | $ 75,000 |
| x) Instrumentation & Control - $1,000,000<br>This item is difficult to assess but we would suggest 1/3 of the requirements would relate to enhanced treatment facilities | $ 330,000 |
| xi) Modifications to Digesters - $500,000<br>This is an allowance suggested for possible repairs/modifications. 50% could be assessed as for upgrade modifications | $ 250,000 |
| Sub-Total | $8,061,000 |
| 10% Estimating Cost | 806,000 |
| TOTAL | $8,867,000 |
| 33% Grant would be | $2,926,000 |
| if only 15% Grant would be | $1,330,000 |

When the plant was re-rated to establish the capacity of the facility at the new discharge criteria the plant was found to have a hydraulic capacity of 4.62 MIGD. The Region feels the enhancement grant should be applied to the lost capacity already installed at the plant. Therefore, we are asking for a 33% enhancement grant on:

$$\frac{12.5 - 4.62}{12.5} \times \$21.2 \text{ million} = \$13.36 \text{ million}$$

instead of $8.87 million. This amounts to an increased request of $1.48 million.

## PANEL DISCUSSION

The final session consisted of a lively panel discussion. Panel members included several of the presenters, with the addition of George Powell, of Gore & Storrie Limited, Werner Lewandowski, of the Ministry of the Environment, and Bruce Jank, of the Wastewater Technology Centre.